

Moles Inquiry Activity

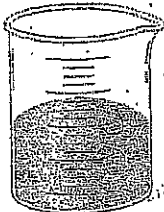
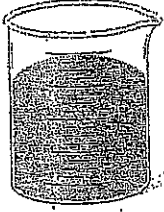

No... Not this kind of mole!



Purpose/Objective

Understand the relationship between the mass of an element and the number of particles (the mole).

The Model

		
Beaker 1	Beaker 2	Beaker 3
55.8 g of iron	111.6 g of iron	112 g of cadmium
1 mole of iron	2 mole of iron	1 mole of cadmium
6.02×10^{23} atoms of iron	12.04×10^{23} atoms of iron	6.02×10^{23} atoms of cadmium

Reviewing the Model

1. Which beaker (1 or 2) has more **atoms** of iron?

2. How many **grams** of iron are in

Beaker 1? _____

Beaker 2? _____

3. How many **moles** of iron are in:

Beaker 1? _____

Beaker 2? _____

4. How many **atoms** of iron are in

Beaker 1? _____

Beaker 2? _____

Exploring the Model

5. Write an equality statement between grams of iron and moles of iron in Beaker 1.

Write an equality statement between grams of iron and moles of iron in Beaker 2.

Is there a relationship between the equality for Beaker 1 and Beaker 2?

6. Write the equality between grams of cadmium and moles of cadmium.

7. Write the equalities above (problems 5 and 6) as conversion factors.

Iron:

Cadmium:

8. Compare this information for each element above to the information on the periodic table. Is there a relationship between the information given and your answers to number 7?

Evaluate Your Understanding

9. If you are given a mole of atoms of each of the following, what would the mass (grams) be?
- Carbon
 - Potassium
 - Chlorine
10. So, how many particles (atoms/molecules/bicycles, etc) in one mole? _____

*****CHECK YOUR ANSWERS BEFORE MOVING ON TO NUMBER 11*****

Exercising Your Knowledge

11. Different elements, their masses and numbers of particles and moles are listed below. Complete the table with the missing information for each element. **DO NOT USE A CALCULATOR.**

Element	Mass of Sample	Number of Particles in Sample	Number of Moles in Sample
Magnesium		6.02×10^{23} atoms	1.00 moles
Arsenic	150. grams		
	23.0 grams	6.02×10^{23} atoms	
Lithium	13.9 grams		
	34.3 grams		0.25 moles
Boron		3.01×10^{23} atoms	
Silicon	56.2 grams		
	40.4 grams	1.204×10^{24} atoms	
Iodine			0.25 moles
	100. grams		0.50 moles

12. If you have two different samples, the first with an actual mass of 100.0 g of silver and the second with an actual mass of 100.0 g of gold, which sample has more atoms (or are they the same)? Explain your answer.
Hint: Set up conversion factors for each substance.

13. You have half a mole of M & M's, how many M & M's do you have?
14. If you have 3.01×10^{23} apples, how many moles of apples do you have?

Mole Calculation Worksheet

- 1) How many moles are in 15 grams of lithium?

$$\frac{15 \text{ g Li}}{6.94 \text{ g Li}} \times \frac{1 \text{ mol Li}}{1 \text{ mol Li}} = 2.16 = 2.2 \text{ moles} \quad \text{g/mol}$$

- 2) How many grams are in 2.4 moles of sulfur?

$$\frac{2.4 \text{ moles}}{1 \text{ mol}} \times \frac{32.07 \text{ g}}{1 \text{ mol}} = 77 \text{ grams} \quad \text{mg/m}$$

- 3) How many moles are in 22 grams of argon?

- 4) How many grams are in 88.1 moles of magnesium?

- 5) How many moles are in 2.3 grams of phosphorus?

- 6) How many grams are in 11.9 moles of chromium?

- 7) How many moles are in 9.8 grams of calcium?

- 8) How many grams are in 238 moles of arsenic?

What are the molecular weights of the following compounds?

9) NaOH

12) H₃PO₄

10) H₂O

13) Mn₂Se₇

11) MgCl₂

14) (NH₄)₂SO₄

Mole Conversions Worksheet

There are three mole equalities. They are:

$$1 \text{ mol} = 6.02 \times 10^{23} \text{ particles}$$

$$1 \text{ mol} = \text{g-formula-mass (periodic table)}$$

$$1 \text{ mol} = 22.4 \text{ L for a gas at STP}$$

Each equality can be written as a set of two conversion factors. They are:

$$\left(\frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ particles}} \right) \quad \left(\frac{6.02 \times 10^{23} \text{ particles}}{1 \text{ mole}} \right)$$

$$\left(\frac{1 \text{ mole}}{\text{g-formula-mass}} \right) \quad \left(\frac{\text{g-formula-mass}}{1 \text{ mole}} \right)$$

$$\left(\frac{1 \text{ mole}}{22.4 \text{ L}} \right) \quad \left(\frac{22.4 \text{ L}}{1 \text{ mole}} \right)$$

Mole-Particle Conversions

1. How many moles of magnesium is 3.01×10^{22} atoms of magnesium?

$$3.01 \times 10^{22} \text{ atoms} \left(\frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ atoms}} \right) = 5 \times 10^{-2} \text{ moles}$$

2. How many molecules are there in 4.00 moles of glucose, $\text{C}_6\text{H}_{12}\text{O}_6$?

$$4.00 \text{ moles} \left(\frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mole}} \right) = 2.41 \times 10^{24} \text{ molecules}$$

3. How many moles are 1.20×10^{25} atoms of phosphorous?

Molar Mass
P 30.97

$$\frac{1.2 \times 10^{25} \text{ atoms P}}{6.022 \times 10^{23} \text{ atoms P}} = 0.199 \times 10^2 \text{ moles P} = 19.9 \text{ moles P}$$

4. How many atoms are in 0.750 moles of zinc?

Zn 65.39

0.750 moles Zn

atoms Zn

5. How many molecules are in 0.400 moles of N_2O_5 ?

N_2O_5

$$2 \times 14.01 = 28.02$$

$$5 \times 16 = 80$$

$$\frac{80}{108.02}$$

0.400 moles N_2O_5

6.022 x 10²³ molecules

1 mole

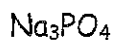
$$2.4088 \times 10^{23}$$

$$\text{molecules} = 2.41 \times 10^{23} \text{ molecules}$$

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Part 1: Molar Mass

Use the periodic table to find the molar masses of the following.

Part 2: Mole ConversionsWork each of the following problems. *SHOW ALL WORK.*

1. How many atoms are in 6.2 moles of aluminum?
2. Convert 5.3×10^{25} molecules of CO_2 to moles.
3. How many formula units of sodium acetate are in 0.87 moles of sodium acetate?
4. Convert 3.55 moles NaCl to formula units.

Moles to Particles (atoms or molecules) NAME: _____

1. How many molecules are in 2.00 moles of H_2O ?
2. How many moles are in 8.30×10^{23} molecules of H_2O ?
3. How many atoms are in 1.87 moles of He?
4. How many formula units are in 1.50 moles of HgCl_2 ?
5. How many molecules are in 2.50 moles of O_2 ?
6. How many moles are in 1.23×10^{50} molecules of $\text{C}_2\text{H}_4\text{O}_2$?
7. How many moles are in 5.25×10^{25} formula units of chromium (IV) sulfate?
8. How many moles are in 8.11×10^{20} formula units of calcium hydroxide?

Moles, Molecules, and Grams Worksheet

1) How many molecules are there in 24 grams of FeF_3 ?

$$\frac{24 \text{ g FeF}_3}{112.85 \text{ g/mole}} \times \frac{6.022 \times 10^{23} \text{ molecules}}{1 \text{ mole}} = 1.28 \times 10^{23} \text{ molecules}$$

$\text{Fe} = 1 \times 55.85$
 $\text{F}_3 = 3 \times 19 = 57.00$
 $\frac{55.85 + 57.00}{112.85}$

molar mass
 Na_2SO_4

$22.99 \times 2 = 45.98$
 $32.07 \times 1 = 32.07$
 $16.00 \times 4 = 64.00$

 142.05 g

2) How many molecules are there in 450 grams of Na_2SO_4 ?

$$\frac{450 \text{ g}}{142.05 \text{ g/mole}} \times \frac{6.022 \times 10^{23} \text{ molecules}}{1 \text{ mole}} = 1.91 \times 10^{24} \text{ molecules}$$

#1

3) How many grams are there in 2.3×10^{24} atoms of silver?

$$\frac{2.3 \times 10^{24} \text{ atoms}}{6.022 \times 10^{23} \text{ atoms/mole}} \times \frac{107.87 \text{ g Ag}}{1 \text{ mole}} = 412 \text{ g Ag}$$

$2.3 \times 10^{24} \text{ atoms}$
 1 mole
 $6.022 \times 10^{23} \text{ atoms}$

4) How many grams are there in 7.4×10^{23} molecules of AgNO_3 ?

5) How many grams are there in 7.5×10^{23} molecules of H_2SO_4 ?

6) How many molecules are there in 122 grams of $\text{Cu}(\text{NO}_3)_2$?

7) (2 step) How many grams are there in 9.4×10^{25} molecules of H_2 ?

$$\frac{9.4 \times 10^{25} \text{ molecules}}{6.022 \times 10^{23} \text{ molecules/mole}} \times \frac{2.02 \text{ g}}{1 \text{ mole}} = 315 \text{ g}$$

$9.4 \times 10^{25} \text{ molecules}$
 1 mole
 $6.022 \times 10^{23} \text{ molecules}$

8) How many molecules are there in 230 grams of CoCl_2 ?

3.2×10^{25}
 320

Name: _____

Molar Conversions: Remember the Bridges!

1) How many moles are present in 34 grams of $\text{Cu}(\text{OH})_2$?

$$34\text{g} \frac{1 \text{ mole}}{97.58\text{g}} = 0.35 \text{ mol}$$

$$\begin{array}{r} \text{Cu } 63.56 = 63.56 \\ \text{O } 16 \times 2 = 32.00 \\ \text{H } 1.01 \times 2 = 2.02 \\ \hline 97.58 \end{array}$$

2) How many moles are present in 2.45×10^{23} molecules of CH_4 ?

$$2.45 \times 10^{23} \text{ molecules CH}_4 \frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ molecules}} = 0.407 \times 10^0 \text{ moles}$$

4) How many grams are there in 3.4×10^{24} molecules of NH_3 ?

$$3.4 \times 10^{24} \text{ molecules} \frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ molecules}} = 0.565 \times 10^1$$

$$\begin{array}{r} \text{N } 14.01 \times 1 = 14.01 \\ \text{H } 1.01 \times 3 = 3.03 \\ \hline 17.04 \end{array}$$

5) How much does 4.2 moles of $\text{Ca}(\text{NO}_3)_2$ weigh?

$$= 5.65 \text{ moles} \frac{17.04\text{g}}{1 \text{ mole}} = 96.3\text{g}$$

6) 3.50 grams of Magnesium Oxide would contain how many formula units?

7) How many grams does 0.500 moles of CuBr weigh?

8) How many molecules are there in 0.655 moles of C_6H_{14} ?

9) How many moles are there in 2.35×10^{24} molecules of water?

10) 6.35×10^{23} molecules of hydrochloric acid would be how many grams?

Mixed Molar Conversions

$K \ 2 \times 39.10 = 78.20$
 $S \ 1 \times 32.06 = 32.06$
 $O \ 4 \times 16 = 64.00$

 174.26

1. How many moles are in 1.20×10^{25} formula units of potassium sulfate?

Formula: K_2SO_4	Molar mass: 174.269 g/mol
$1.20 \times 10^{25} \text{ formula units}$	$\frac{1 \text{ mole}}{174.269 \text{ g}} \times 1.20 \times 10^{25} = 19.9 \text{ moles}$
$6.022 \times 10^{23} \text{ formula units}$	
Answer: 19.9 mol	

2. You need 2.5 moles of Iridium for an experiment. How many atoms of iridium is this?

Formula: Ir	Molar mass: 192.22 g/mol
2.5 mol	$\frac{6.022 \times 10^{23} \text{ atoms Ir}}{1 \text{ mol}} \times 2.5 = 15.05 \times 10^{23} \text{ atoms}$ $= 1.5 \times 10^{24} \text{ atoms}$
Answer: $1.5 \times 10^{24} \text{ atoms}$	

3. 380 g of carbon trifluoride would equal how many moles?

Formula: CF_3	Molar mass: 69.01 g/mol
$\frac{12.01}{51} = 69.01 \text{ g}$	$\frac{380 \text{ g}}{69.01 \text{ g}} \times 1 \text{ mole } CF_3 = 5.5 \text{ moles } CF_3$
Answer: $5.5 \text{ mol} = 5.5 \text{ moles}$	

4. There are 3.20×10^{22} atoms of copper in the outer shell of pennies. How many grams of copper is this?

Formula: Cu	Molar mass: 63.55 g/mol
$3.20 \times 10^{22} \text{ atoms}$	$\frac{63.55 \text{ g}}{6.022 \times 10^{23} \text{ atoms}} \times 3.20 \times 10^{22} = 33.8 \times 10^{-1} \text{ g}$ $= 3.38 \text{ g}$
Answer: 3.38 g	

5. If you pump 408.8 g of hydrofluoric acid into a tank, how many molecules of hydrofluoric acid are you using?

Formula: HF	Molar mass: 20.01 g/mol
$\frac{408.8 \text{ g}}{20.01 \text{ g/mol}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} = \frac{246098 \times 10^{23}}{20.01} = 1230 \times 10^{23} = 1.230 \times 10^{25}$	
Answer: 1.230×10^{25}	

6. If you have 0.975 moles of calcium phosphate, how many grams of calcium phosphate do you have?

Formula: Ca_3PO_4	Molar mass: 135.05
$0.975 \text{ moles} \times \frac{135.05 \text{ g}}{1 \text{ mole}} = 131.7 \text{ g}$	
Answer:	